

Appl. No.: 10/698,502  
Amdt. Dated: 4 January 2006  
Reply to Office Action of: October 4, 2005

### REMARKS/ARGUMENTS

#### 1. Claims

Claims 24 - 40 remain in this application. No claims have been amended.

#### 2. Drawings

The Examiner has indicated in the accompanying form PTO-948 that there were no formal drawings previously submitted. Applicants agree.

#### 3. § 102 Rejections

##### A. U.S. Patent No. 3,655,354 to Quandt

The Examiner has rejected claims 24 and 27 - 39 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 3,655,354 (Quandt). Specifically, the Examiner asserts that Quandt teaches a high permeability graphite crucible having a permeability of about 100 milli Darcys (greater than  $14 \text{ cm}^2/\text{s}$ ). Applicant traverses the rejection.

The Quandt patent teaches the use of carbon crucibles that have been treated a solution of a salt of aluminum or other metal to produces boules of fused quartz. Quandt *does not teach* the use of crucibles that have not been treated with a metal salt solution. Other metals specified in Quandt are those capable of reacting with quartz to produce metal silicates, such metals including magnesium, calcium, beryllium zirconium and hafnium. It is also noted that Quandt is disclosing a method for making *fused quartz* not *crystalline quartz*. Fused quartz is a glass.

What is the difference between a glass vs. a crystalline material?

Glass is an amorphous solid, which means there is no order in the positioning of the atoms that make up the solid. A crystalline material can have the exact same type and amount of atoms as a glass, but the atoms are ordered in a very well defined and rigid pattern. A single crystal, in theory, has all atoms oriented in the exact same pattern. Crystalline quartz vs fused quartz glass is a good example of the same atoms ( $\text{SiO}_2$ ) being a crystal, or a glass, depending on their ordering. Both crystalline

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solids and glasses are normally colorless in the pure state. It is added impurities that give color to glass and crystals. The impurities also change the mechanical, thermal, and optical properties of both materials.

First, the present invention is directed to making single crystals of calcium fluoride ("CaF<sub>2</sub>") that have increased far-ultraviolet transmission characteristics. Quandt is directed to making an amorphous "quartz glass." The fused quartz glass produced by Quandt is different from a single crystal of quartz as explained above. The method and material requirements for producing single crystals are different from those used to produce glasses. Consequently, applicant submits that Quandt is not a proper anticipation citation because it lays in a different field of art (glass) than does the present invention (single crystals).

Second, in order for CaF<sub>2</sub> crystals to possess the desired far-ultraviolet ("far-UV") transmission properties recited in the claims, the crystals must be free as possible of impurities such as other metals like aluminum, hafnium and other recited by Quandt. If these metals are present in the carbon crucible they can migrate into the CaF<sub>2</sub> melt. The presence of these metals in a grown CaF<sub>2</sub> crystal can destroy the CaF<sub>2</sub> crystal's symmetry and produce birefringence and/or they can give rise to color centers. [Note that the ionic radius, in Angstroms, of Al<sup>+3</sup> is ~0.5 versus ~0.99 for Ca<sup>+2</sup>, F<sup>-</sup> having an ionic radius of ~1.33]. Regardless of the effect, the CaF<sub>2</sub> crystal would be useless for far-UV applications. Consequently, applicant submits that Quandt, in teaching the use of carbon crucibles contain metal salts, teaches away from applicant's claimed invention.

THEREFORE, in view of the foregoing facts and arguments concerning the differences between Quandt and the claimed invention, applicant respectfully submits that Quandt does not anticipate the claimed invention and that it is proper for the Examiner to withdraw the §102(b) rejection over Quandt.

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**B. Japanese Patent Application JP 09-0328392A to Okubo, et al.**

The Examiner has also rejected claims 24 – 40 under 35 U.S.C. 102(b) as being anticipated by JP090328392A (Okubo, et al, machine translation enclosed). Specifically the Examiner asserts that Okubo teaches a graphite crucible with a porosity of 10-20%. Applicant traverses the rejection.

Okubo teaches the use carbon lid of porosity in the range of 10-20%. However, permeability and porosity, or even pore size, do not go hand-in-hand. Consequently, one cannot assume that because Okubo teaches a porosity of 10-20% it also teaches a permeability of greater than  $4 \text{ cm}^2/\text{s}$

Applicant's invention describes a method of making optical quality alkaline earth metal fluoride single crystals grown as disks in a graphite crucible having permeability greater than  $4 \text{ cm}^2/\text{s}$  as measured according to DIN 51935. As indicated in applicant's Table 1, porosity and permeability are not the same measure. In Table 1 the Type B and C carbons have approximately the same porosity (B = 16.1% and C = 16.7%), but they have much different permeabilities (B = 2.6 and C = 4.6). As applicant indicates in Paragraph [0070], while lead (Pb) is found in a single crystal made using the Type B carbon crucible, no lead is found in a single crystal made using the Type C carbon crucible. Table 1 indicates that a crystal grown in a Type B crucible has 5-20 ppm Pb contamination, whereas one grown in a Type C crucible has <0.2 ppm Pb contamination. The difference is from 1 to more than 2 order s of magnitude.

The purpose for using a permeable crucible such as a Type C carbon crucible is to permit the discharge of impurities from metal fluoride melt so that they are not included in the single crystal when it is formed. As taught by applicant's specification the quality of the resulting alkaline earth metal fluoride single crystal will be improved by volatilization through the walls of the permeable crucible. The impurity of primary interest is volatile lead oxide (PbO) that is formed by a reaction between any alkaline earth metal oxide (e.g., CaO) that may be present and an oxide scavenger such as  $\text{PbF}_2$ . (See specification, Paragraphs [0014] and [0041]). [Carbon

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dioxide would be removed if a fluorocarbon such as Teflon were used as the fluorinating agent.] In contrast to Okubo, Applicant specifically teaches the use of crucibles having a *permeability* greater than  $4 \text{ cm}^2/\text{s}$ . Permeability is the key factor.

Again referring to applicant's Table 1, it is also clear that not only does porosity not correlate to permeability, but pore size also does not correlate to applicant's teaching concerning permeability. For example, in Table 1 the Type A carbon has an average pore size of  $2.2 \text{ }\mu\text{m}$ . However, the metal fluoride single crystal formed using the Type A crucible had a lead content in the range of 1,000 - 1,500 ppm, which is completely unacceptable. It should be also noted that the Type A carbon crucible had a porosity of 15.8% and a permeability of  $0.13 \text{ cm}^2/\text{s}$ . Referring to the Type B carbon crucible of applicant's Table 1, this crucible has a porosity of 16.1%, an average pore size of  $19.1 \text{ }\mu\text{m}$ , and a permeability of  $2.6 \text{ cm}^2/\text{s}$ . The Type B crucible produces an alkaline earth metal fluoride single crystal having a lead content in the range of 5-20 ppm; an unacceptable level. It is only when one uses a crucible having a permeability greater than  $4 \text{ cm}^2/\text{s}$ , for example, the Type C and D crucibles of applicant's Table 1, can one make an alkaline earth metal fluoride single crystal having a sub-ppm level of lead in the crystal.

THEREFORE, in view of the foregoing facts and arguments, applicant respectfully submits that that Okubo does not anticipate the claimed invention and that it is proper for the Examiner to withdraw the §102(b) rejection over Okubo

Based upon the above amendments, remarks, and papers of records, applicant believes the pending claims of the above-captioned application are in allowable form and patentable over the prior art of record. Applicant respectfully requests that a timely Notice of Allowance be issued in this case.

Applicant believes that no extension of time is necessary to make this Reply timely. Should applicant be in error, applicant respectfully requests that the Office grant such time extension pursuant to 37 C.F.R. § 1.136(a) as necessary to make this Reply timely, and hereby authorizes the Office to charge any necessary fee or surcharge with

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respect to said time extension to the deposit account of the undersigned firm of attorneys,  
Deposit Account 03-3325.

Please direct any questions or comments to Walter M. Douglas at 607-974-2431.

41 January 2006  
Date

<p><b>CERTIFICATE OF TRANSMISSION</b> <b>UNDER 37 C.F.R. 6.18</b></p> <p>I hereby certify that this paper and any papers referred to herein are being transmitted by facsimile to the U.S. Patent and Trademark Office at 571-273-8300 on:</p> <p><u>4 January 2006</u> Date</p> <p><u>Walter M. Douglas</u> <u>4 Jan 2006</u> Walter M. Douglas Date</p>
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Respectfully submitted,  
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